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8 Adaptive Management and Monitoring Commitments

The Commitments

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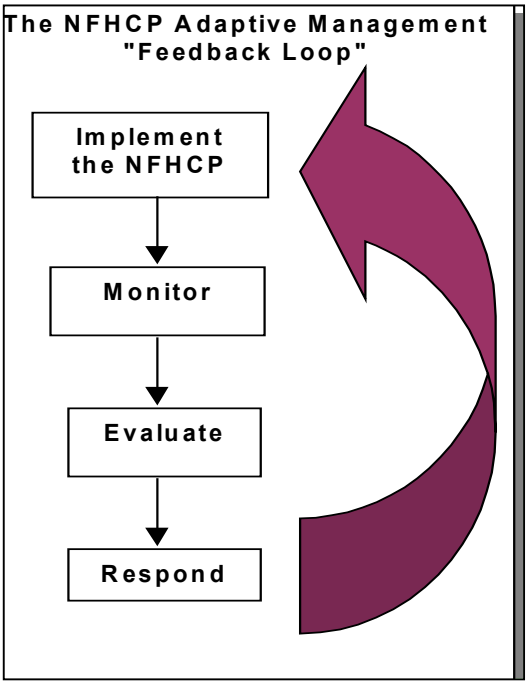
Adaptive management is a strategy used in conservation planning whereby goals for the plan are set, information is collected to evaluate whether the goals are being met, and management is adjusted if necessary to ensure success in achieving the goals. This results in a "feedback loop" that incorporates better scientific understanding into everyday management practices.

From a biological viewpoint, the NFHCP is a very large applied science undertaking whereby Plum Creek implements certain standards and practices with the expectation of achieving a desired goal. This goal is broadly defined as the conservation of native fish and their habitat in the Project Area while protecting the long-term business needs of Plum Creek. This overall goal is then more specifically described by the NFHCP biological goals (Table NFHCP1-2) and the NFHCP business goals (Table NFHCP1-3). Management actions to be implemented under the NFHCP range from routine monitoring to innovative restoration efforts.



The NFHCP is a complex **science plan**, which is dependent upon the best technical information available and must rely on predictive models to ensure long-term conservation certainty. However, the NFHCP is also a **business agreement**, as it represents the commitment of substantial financial resources in its preparation and implementation as an investment to ensure long-term business predictability and the commitment of "No Surprises" assurances by the Services. The scientific side of adaptive management must provide the platform to rigorously test whether the biological goals of the NFHCP are being met and to guide changes to the plan that ensure success, if needed. To achieve the business goals and preserve practicability, the adaptive management process must place thoughtful evaluation criteria and economic "sideboards" on monitoring strategies and possible management responses. This will ensure that the business goals of the NFHCP continue to be met, the economic and operational viability of Plum Creek is preserved, and the promise of no surprises is fulfilled. The adaptive management commitments specify the terms under which the conservation commitments established by the NFHCP might be modified to meet biological goals. This balanced approach recognizes both the business needs of Plum Creek and the science-based objectives of the Services.

The NFHCP relies on the conservation commitments and prescriptions of the previous sections to ensure the NFHCP biological goals and ESA permit issuance criteria are met. The commitments of the NFHCP were constructed using the best science available and provide a reasonable level of certainty that biological goals will be met. Ideally, the plan will be successful and no management responses will be required. However, complete certainty that any plan will be successful is difficult if not impossible to achieve. It would require either having extremely conservative conservation measures that may only provide negligible benefits or would mean postponing conservation until we have "perfect knowledge." Neither of these approaches is desirable. NFHCP adaptive management is, therefore, a balance between strong commitments at the outset and a procedure for improving them in the future if that becomes necessary.

In a regional plan such as the NFHCP, there is also uncertainty associated with the specific success of conservation measures in a specific location or watershed. In the development of the NFHCP scientific studies, consideration was given to how fine a scale at which success of the plan should be evaluated. It became very clear that the cost of data gathering to resolve these uncertainties increases exponentially the smaller the scale that is sought. At some point, it becomes more cost-effective to resolve those uncertainties by increasing the rigor of the commitment at the outset rather than to spend more resources merely studying the commitments. The draft NFHCP was improved by the addition of more specific initial commitments developed following public comment as well as by a more detailed description of the studies that will be conducted to help address these scale concerns.

This section of the NFHCP is organized as follows:

- **Monitor:** How will information be collected to guide the adaptive management process?
- **Evaluate:** How will the monitoring data be used to guide adaptations to the NFHCP?
- **Respond:** What procedures will be used when Plum Creek and the Services need to agree on effective and appropriate adaptations?
- **Adaptive Management Commitments:** What are Plum Creek's commitments for implementing the NFHCP adaptive management strategy?

Monitor

The first step in the NFHCP Adaptive Management Strategy is simply to collect information on how the plan is going.

Two primary types of monitoring will generate feedback for evaluating the success of the plan to the Services and Plum Creek over the life of the NFHCP: 1) implementation monitoring; and 2) effectiveness monitoring. Because of the breadth and complexity of the NFHCP, implementation monitoring will provide a continuous stream of information to gauge compliance with individual conservation measures (e.g., riparian prescriptions) and implementation targets (e.g., road upgrading schedules). Effectiveness monitoring involves experimental research to determine if the commitments are in fact achieving the Biological

Goals and Specific Habitat Objectives of the NFHCP. It also involves work to validate models that were used to increase confidence that expected results will indeed be achieved. With credible information on NFHCP implementation throughout the Project Area, effectiveness monitoring results (developed for a subset of the Project Area) can be reliably extrapolated to the entire Project Area.

Implementation Monitoring

Implementation monitoring involves tracking NFHCP commitments that occur or re-occur throughout the permit period and simply determining whether or not these activities were properly done ("yes" or "no"). NFHCP commitments tracked using implementation monitoring generally involve measures whose benefits are fairly certain, and do not require elaborate or complex study designs. Seeding and mulching of a newly constructed road (R2) is an example of an NFHCP commitment that would be evaluated under implementation monitoring; that is, a site inspection would reveal whether the new road had been seeded ("yes") or not ("no"). Because of the higher level of certainty involved with commitments tracked using implementation monitoring, management responses to implementation monitoring results are very specific and well defined in advance. For example, if the new road has been seeded, no action is needed; if it has not, then the road would be immediately seeded. Costly experimental study would not be needed to determine how to "right the wrong"—the commitment would simply be done properly as soon as possible.

Components of the NFHCP that would be evaluated using implementation monitoring are listed in Table NFHCP 7-1.

Effectiveness Monitoring

All the commitments outlined in the NFHCP are expected to benefit fish, but some commitments provide more certain benefits than others. Some may even be considered experimental measures because their benefits have not yet been determined using rigorous scientific methods and experimental design. For those commitments where the benefit for fish is less certain, scientific study is used to make a judgement on their effectiveness. The scientific study can then also provide information useful in developing management responses that are appropriate. This process is called **effectiveness monitoring**.

Effectiveness monitoring for the NFHCP will be undertaken in four **Core Adaptive Management Projects (CAMPs)** that are described below and discussed in more detail in Appendix AM-1. These are mostly "**experimental management**" projects (Plum Creek 1999b) and are designed to test key hypotheses and assumptions used to develop NFHCP commitments. Data acquired in these projects will also be used to evaluate the success of meeting the biological goals of the NFHCP. The CAMPs will provide key information required by the NFHCP implementation framework and will be used in the decision process described below as the "Adaptive Management Pathway," to help inform other less structured management responses proposed in the NFHCP. They are, in effect, major "drivers" of the NFHCP adaptive management provisions.

In addition to experimental management, the CAMPs will also include some "**basic research**" projects, where causal relationships between activities and effects are more speculative at present. The objective of basic research is to establish cause-and-effect relationships between forest management activities and their effects on resource concerns where they are not well understood; these causal linkages may eventually be used in the adaptive management process.

CAMP monitoring and research will be dispersed throughout the entire Project Area. Sites and watersheds used for sampling will be representative of the dominant geologies, landforms, and climates found in the Project Area. As such, results from these studies can be reliably extrapolated to the larger Project Area (landscape scale) using the performance metrics reported under implementation monitoring. Physical and biological monitoring undertaken will utilize un-harvested control sites as well as experimental (treatment) areas.

While NFHCP effectiveness monitoring is primarily focused on the measurement of fish habitat components, some biological data will be collected to improve understanding of the relationships between measurable habitat components and the well-being of the fish themselves. This will also provide information on "**biological relevance**," an important checkpoint in the Adaptive Management Pathway described later. The majority of the biological monitoring data collected will focus on the potential effects of management actions upon habitat utilization by fish. That is, fish species diversity, age-class distribution, population density, and physical habitat components will be measured at both control and treatment areas to determine whether a plan-induced modification of habitat results in a net-reduction of habitat utilization. This information is directly applicable in a determination of biological relevance when evaluating the effectiveness monitoring data collected.

The four Core Adaptive Management Projects are briefly described below and in more detail in Appendix AM-1:

- **CAMP 1** (Evaluation of Road BMP Effectiveness)—This project will involve the following:
  - Collecting data on the long-term trend in sediment delivery from Plum Creek roads.
  - Validating erosion coefficients used in erosion and sediment delivery models.
  - Collecting long-term data on stream response to implementing NFHCP sediment reduction measures (e.g., instream fine sediment, pools, etc.) versus control watersheds.
- **CAMP 2** (Evaluation of the Effects of Riparian Management on Woody Debris Loads and Fish Habitat Diversity)—This project will accomplish the following:
  - Validate assumptions used to forecast LWD loads in forested reaches
  - Validate assumption of differing fish habitat responses to LWD among channel gradient classes

- Monitor trends in undercut banks in non-forested reaches with grazing.

- Collect fish abundance data to evaluate the biological relevance of expected trends in LWD loads.

- **CAMP 3** (Evaluation of NFHCP Effectiveness at Minimizing Stream Temperature Increases)—This project will accomplish the following:

  - Monitor reach-scale temperature changes associated with timber harvests conducted per NFHCP riparian commitments (temperatures will be monitored before and after harvesting).

  - Evaluate watershed-scale temperature changes.

  - Collect biological data to evaluate the biological relevance of any documented changes in stream temperature.

- **CAMP 4** (Long-Term Effectiveness of Plum Creek's Grazing BMPs)—This project will establish a network of long-term monitoring reaches to evaluate trends in physical stream channel attributes, riparian conditions, and the biological community in response to implementing Plum Creek's Grazing BMPs. Data will be collected in control reaches, and in reaches with a variety of treatments (e.g., full exclosure, rest-rotation grazing, and season-long grazing per the BMPs).

	Status	Timing for Completion
CAMP 1	This CAMP is well developed. Four sediment tubs were installed in July of 2000 in the Schroeder Creek watershed as a pilot project to debug the procedure this year. The sediment trapping study will be fully operational in 2001 with an additional 28 tubs installed. The Plum Creek fish crew has been collecting McNiel cores in treatment and control watersheds to begin to examine trends in intergravel fine sediment.	Final study plan completed in winter of 2001.
CAMP 2	The study plan is well developed with initial data for the tree lean analysis being collected in the summer of 2000. The study will be fully operational in the summer of 2001.	Final study plan completed in winter of 2001.
CAMP 3	The study is about 95% complete. In July 2000 Plum Creek installed temperature-logging equipment in 11 planned streamside timber harvest areas, including miniature weather stations to measure changes in microclimate.	Final study plan completed in fall of 2000.
CAMP 4	This plan is the least developed, as acknowledged in Table NFHCP 8-1B. This study will be developed in cooperation with the University of Montana the Fall of 2000.	Final study plan completed in winter of 2001.

Evaluate: The Tools for Applying Adaptive Management

Once information is collected through monitoring, it will be evaluated to determine whether the goals of the plan are being met and what modifications might be required to maintain NFHCP effectiveness.

The NFHCP Implementation Framework

How is all of this information assembled to guide responsive management? The NFHCP uses the **NFHCP Implementation Framework** as a tool to evaluate the monitoring data and to guide operational adaptive management. This Framework appears as a lengthy table (Table NFHCP8-1), which appears later in this section following Commitment AM2. The Framework forms a working feedback loop, starting with the broadest NFHCP goal and proceeding to develop the smallest of individual management responses. The elements of the Implementation Framework are introduced here:

- **The Conservation of Native Salmonids**. This is the overriding objective of the NFHCP from which the biological goals are developed.

- **Four Biological Goals**. Because the intent of adaptive management is to ensure that all of the NFHCP biological goals are being met, each of the four goals introduced at the beginning of the NFHCP (Table NFHCP1-2) is addressed individually within the Implementation Framework.

- **Fifteen Specific Habitat Objectives.** These are the measurable habitat components established to guide the development of conservation commitments that contribute to meeting the biological goals. Several habitat objectives are specific to each biological goal. If the habitat objectives are being achieved, then it is assumed that the biological goals are met.

- **Management Actions (i.e., NFHCP Commitments).** For each habitat objective, all of the commitments of the NFHCP designed to contribute to that objective are identified. It is these management actions that must be evaluated to determine success. In the Implementation Framework, the appropriate NFHCP commitment is referenced after the Specific Habitat Objective so the reader can refer back to the detailed description of that commitment in earlier sections of the NFHCP.

- **Performance Metrics.** For each management action shown in the Framework, the NFHCP establishes one or more units of measurement used to evaluate success of the action. These are termed "performance metrics." When a metric is stated in the Implementation Framework, a reference is provided to show where in the NFHCP it can be found. Some of these metrics are derived from implementation monitoring, while others are science-based and derived from effectiveness monitoring.

  – Implementation Monitoring—Is a commitment being implemented properly? For these, the performance metric will be a numeric tally of straightforward "yes" or "no" observations; i.e., "yes," it is being implemented properly, or "no," it is not.

  – Effectiveness Monitoring—Is the management action effective at achieving the intended conservation benefit? This is generally a statistical or numeric measurement resulting from experimentation described in one of the CAMP studies.

- **Triggers.** For each performance metric, a threshold is established in the NFHCP that serves as the indicator, or "trigger," at which point the adaptive management process starts. A trigger is selected because it serves as an "early warning indicator" of results that may be biologically relevant. Therefore, it must be measurable in a time frame that is meaningful for informing management changes. These triggers are derived from conservation expectations established during the development of the plan and set forth in the NFHCP.

  - For numeric metrics derived in a straightforward manner from implementation monitoring, the trigger is stated in the implementation framework set forth in Table NFHCP8-1. For these metrics, the adaptive management process involves the direct, non-discretionary steps called for in the "management response" section described below and in the table.

  - For science-based triggers derived from effectiveness monitoring and the CAMPs, the trigger is identified briefly in the Framework Table, but a reference is provided to the Trigger Detail Table (Table NFHCP8-2), which follows Table NFHCP8-1 and describes it in more detail. These triggers would be tripped when the scientific work identifies a difference between the results achieved by the conservation measures and the expected results of those measures. These are described specifically for each trigger in the CAMP tables as a measurable parameter; some include statistical significance requirements. Control areas used in the CAMP study designs are those sites in which no management activity would occur (or by using "before and after" analysis [i.e., the control is the "before" condition]) and that resemble the managed area in as many ways as possible. When conditions trip these triggers, the Adaptive Management Pathway (described below) is initiated.

The NFHCP includes a provision that allows a given trigger to be changed through the collaborative management agreement process. For example, a numeric trigger could be increased and therefore strengthened if it can be demonstrated that the conservation being provided "is not enough" in that it allows for a detrimental outcome for the covered species of fish. Or a numeric trigger might be reduced if it is shown that, despite the trigger being tripped, no resource concern is occurring as a result. For instance, rather than continually "tripping" the trigger for no reason, it would be changed to a more meaningful number.

- **Management Response.** After the trigger is tripped for a given performance metric, the management response process begins. In the case of basic implementation monitoring, the step from trigger to management response is direct and requires no interpretation or decision making and agreement process between Plum Creek and the Services. Plum Creek would simply follow a predetermined course action to ensure that NFHCP commitment is properly implemented (i.e., any NFHCP measure that has not been implemented or has been improperly implemented would be corrected). In contrast, when a science-based trigger resulting from NFHCP effectiveness monitoring is tripped, the decision on a management response requires the implementation of the **Adaptive Management Pathway**. The decision process in this pathway is summarized in the following discussion and is spelled out more specifically for each CAMP in Appendix AM-1.

The Adaptive Management Pathway

When the step is taken from trigger to management response because of the input of new scientific information and effectiveness monitoring, the feedback loop involves an extra layer of scientific rigor to ensure that the appropriate questions are asked and that a scientifically based management response is developed. This is referred to as the Adaptive Management Pathway and is represented in the inset box of Figure NFHCP8-1. This provides assurance to the Services that new scientific information will lead to science-based changes in management and assures Plum Creek that any need to implement more costly measures is the conclusion of a scientifically rigorous process. In the NFHCP, science-based triggers invoke the Adaptive Management Pathway as a mandatory response—a process that can lead, if appropriate, to collaboratively developed and agreed management changes. It is important to note that the pathway itself is a part of the collaborative management response process. Plum Creek and the Services will mutually address questions of biological relevance and causal linkage as well as developing a management response.

Where do "Cooperative Management Responses" come into the picture?

The Adaptive Management Pathway describes a scientifically rigorous process that provides for required changes to management under certain conditions. However, many times an opportunity to adapt management in a straightforward and cost-effective way will become evident to both Plum Creek and the Services that all can agree to without the need for walking through all of the process. The NFHCP Adaptive Management Strategy provides for taking advantage of these opportunities by providing for the opportunity to incorporate "Cooperative Management Responses." Using this approach, either party can propose a change in good faith intended to improve the NFHCP. If agreement is reached, it is incorporated as an enforceable part of the NFHCP. If not and a trigger has been "tripped," the NFHCP specifies that the more scientifically rigorous Adaptive Management Pathway procedure will be used to adapt management.

Biological Relevance. The first step after a science-based trigger has been observed is to determine if the observation has any biological relevance in order to determine if the departure in expected results is affecting the biological goals of the plan. The triggers are based upon measurable habitat variables and were selected on the basis of the estimated conservation benefit provided by the NFHCP. After using these variables to calculate the expected conservation benefit, they then become the tools for measuring success. Measuring habitat variables is more practical than counting fish and is more directly related to Plum Creek's management activities. However, simply observing a trigger based on habitat variables does not automatically infer that fish utilization of that habitat will decline or that fish are adversely affected. While the trigger was chosen as an "early warning indicator" that infers biological relevance, it was also chosen because it is easily measurable in a time frame that is soon enough to inform a management response in time to make a meaningful management correction. Therefore, it may or may not actually indicate biological relevance. The reason for making a determination of biological relevance after observing a trigger is to ensure that the observation of a trigger is really detrimental to fish before requiring a costly management change.

The NFHCP Implementation Framework: A Feedback Loop

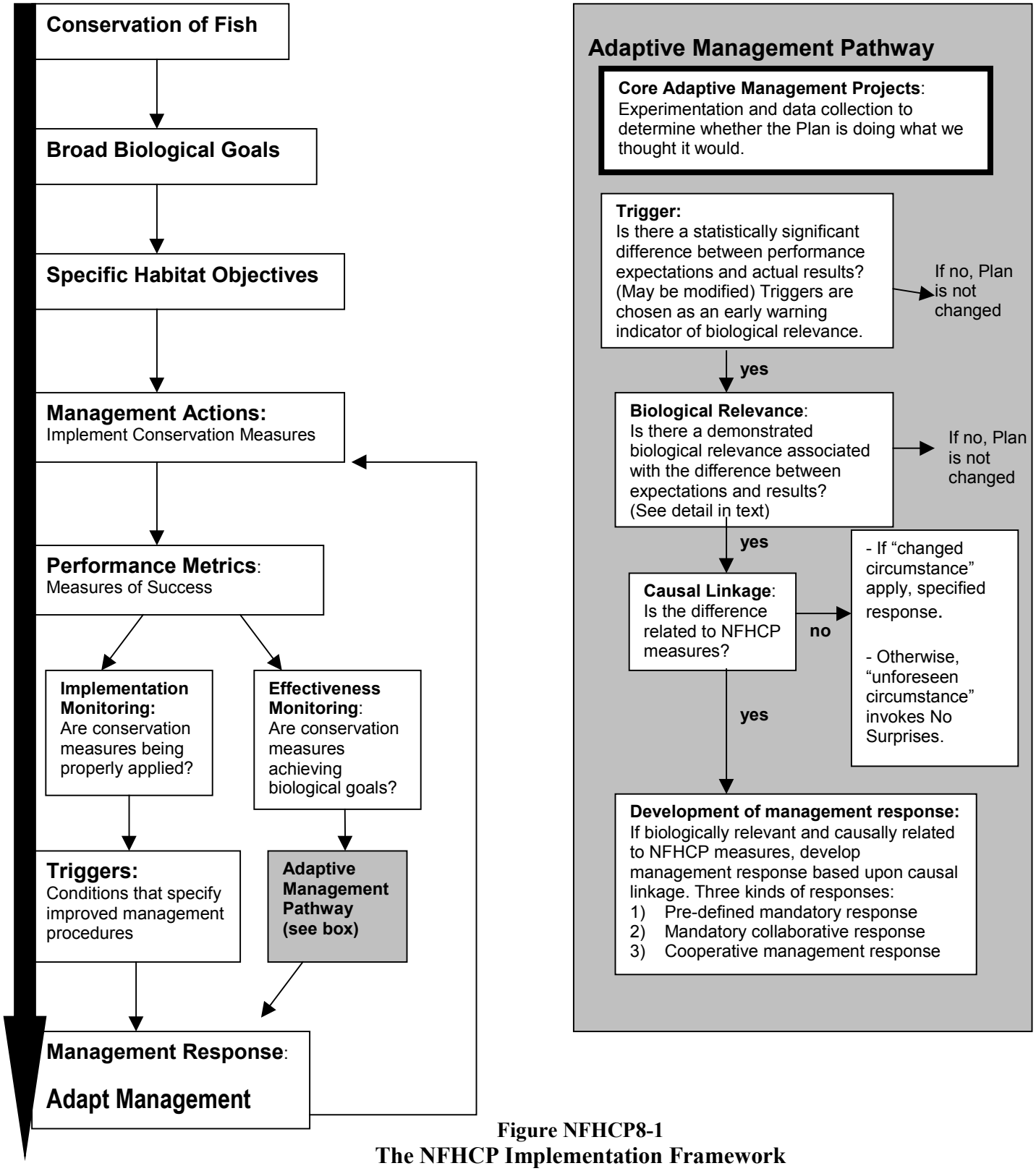


Figure NFHCP8-1
The NFHCP Implementation Framework

For the NFHCP, a "**biological relevance determination**" will be used to identify whether the tripping of a trigger negatively affects the conservation of Permit species, indicating that the plan is falling short of meeting the NFHCP biological goals. This can directly be observed by measuring the extent to which the fish use the habitat that may have been impacted (known as "habitat utilization"), or by other means shown in the bullet points below. The determination of biological relevance will be made mutually by Plum Creek and the Services considering one or more of the following kinds of evidence:

- Permit species habitat utilization in managed (experimental) versus control reaches of streams in the Project Area or vicinity.

- Definitive relationships between habitat utilization and the habitat parameters being measured by the triggers that can be used to infer impacts to similar areas where habitat utilization is not being measured.

- The context of overall habitat quality trends, which evaluates a trigger in the context of overall trends for other habitat parameters that may contribute to the relevance determination.

- The context of baseline habitat conditions, which is the evaluation of a trigger in the context of an existing habitat baseline that may contribute to the relevance determination.

- Other data or definitive information (e.g., peer-reviewed scientific articles from professional journals) that can inform a determination of whether an observed trigger negatively affects the utilization of habitat by Permit species.

The intent of a biological relevance determination is to ensure that the NFHCP measures will not be subject to changes unless change is needed to achieve the NFHCP biological goals.

Causal Linkages. If a trigger is tripped and biological significance is demonstrated, a determination of "causal linkage" is the next step taken in order to determine the source of the change or departure detected. Three sources of the change are possible. One source may be changes in circumstances that do not result from Plum Creek's activities, but were anticipated and for which some contingencies were prepared. Examples of these "**changed circumstances**" include fires, floods, and landslides (Commitment AM3, *Changed Circumstances*). A second source of change observed in the monitoring data could be the inadequacy (or over-performance) of NFHCP management measures and prescriptions. Third, the source of change may be **unforeseen circumstances** not anticipated by the NFHCP. Examples of such events may be large wildfires or increased timber harvest activity on other ownerships. In these cases the "No Surprises" rule (FR 1998b) would be operative and the Services would work with Plum Creek to make adjustments to operating procedures in accordance with that rule (and the Implementing Agreement [IA]).

Management response development. Once the linkage between the NFHCP and the source of departure from expectations is determined, then study data are used to develop an appropriate management response. The highest level of business certainty for Plum Creek would involve a pre-defined contingency plan implemented if management needs to be changed. However, if a more appropriate prescription were identifiable at the outset of the

plan, it would have been used. Because a change in management should be based upon new or better scientific information rather than a pre-determined default response (that is, based on less science), the most appropriate response may need to be developed after that science is available. The CAMP study data will be used to identify causal linkages between management activities and impacts to fish and the specific situations or locations in which these linkages occur. This information will then be used to develop specific and tailored refinements in NFHCP commitments if triggers are tripped and a management response is required While future management responses may not have been identifiable at the outset of the NFHCP, the assurance Plum Creek receives under this process is that any responses identified later will be scientifically credible and will be applied within the bounds of effectiveness.

Planning Area Basins may serve as an appropriate scale for modifying triggers, evaluating biological relevance, assessing causal linkages, and developing management responses. Triggers can be set at a variety of scales. The sediment trigger (see Trigger "C" in Table NFHCP8-2) is presently set at the landscape scale. As more information becomes available, a finer-scale trigger may be proposed (such as for a given Planning Area Basin or individual watershed). Conversely, other triggers (e.g., Trigger A—temperature) are presently set at a reach scale. Further research may indicate that the watershed scale is more appropriate. Planning Area Basins may also be used as a boundary for the extent of a biological relevance determination since some species (e.g., steelhead, coastal cutthroat) only occur in a few basins. While causal linkages will most likely be made for a given geology, landform, or channel type, it is possible that a linkage could be made specific to a particular Planning Area Basin.

It is important to note that adaptive management is a "two-way street" in habitat conservation plans. That is, information and experience obtained from research and monitoring may suggest the applicant can meet biological objectives with more, or less, restrictive conservation measures. Consequently, monitoring data that demonstrate that targets and trends have been met and exceeded could be the basis for adoption of relaxed practices. In the NFHCP, exceeding the conservation targets can be the basis for the following:

- A proposal by Plum Creek to collaboratively relax the Adaptive Management triggers,
- A "cooperative management response" proposal by Plum Creek for more economical approaches to effective conservation commitments, or
- A demonstrated opportunity to shift resources to areas where success may be less certain.

The CAMP studies are specifically designed to better describe the relationships between Plum Creek management actions, the habitat variables being used for evaluating triggers, and the successful utilization of habitat by Permit species. These studies will provide data that will be used to:

- Determine when triggers are tripped
- Determine when triggers need to be changed
- Make biological relevance determinations

- Help design cooperative or collaborative management responses
- Provide information describing causal linkage relationships.

The conceptual designs for how CAMP studies will collect information for making biological relevance determinations are described in Appendix AM-1.

Respond

After monitoring data are evaluated and appropriate management responses have been developed, they need to be incorporated into the everyday practice of the NFHCP, thus completing the feedback loop.

Important Economic Considerations

Implementing management responses to meet biological goals that involve an additional commitment of resources by Plum Creek are essentially an agreed exception to the No Surprises assurances. Because economic predictability is a fundamental incentive offered to Plum Creek through No Surprises, management responses cannot be arbitrary and should meet certain economic considerations.

Demonstrated causal linkages and tailored solutions. As described above, management responses "triggered" under adaptive management must be based upon demonstrated "causal linkages," so little is left to speculation concerning whether a problem exists or a solution is required. An HCP applicant is expected to bring science to the HCP planning process so conservation measures developed are based upon the best scientific understanding possible at its outset. Increased scientific understanding as the plan progresses should be applied to making specific management prescriptions respond and change according to that better understanding. Management responses should improve the certainty of the plan being equal or better for conservation while at the same time being equal or better for business. As new information is obtained either through Plum Creek monitoring and scientific research under the NFHCP or through other scientific data that suggests some portion of the conservation strategy may require correction, resources and effort must be directed at resolving that problem in a site-specific manner. It is standard business practice to solve problems in a specific manner without expending scarce resources on approaches that are not cost-effective. It is also the trend of public policy and regulatory reform efforts to design regulations to be more site-specific, prescribing specific regulations to address specific situations. This is the best approach to minimize resource risk while controlling expenses.

Shifting resources to meet new demands. An important economic principle for Plum Creek under a functional adaptive management program involves the ability to reallocate resources if necessary. When management responses indicated by adaptive management require an additional commitment of resources, they will first be financed by reallocating conservation from other areas where it can be demonstrated that Plum Creek is exceeding conservation goals, to the extent that such a conservation surplus is available. If a surplus is not available, Plum Creek will still fulfill its commitment to change management in order to meet the biological goals. In addition, savings obtained by reducing commitments in response to new information can be reapportioned to supplement other areas where there is concern or

uncertainty about meeting biological goals whether or not a trigger is tripped through a cooperative management response. The principle of seeking a reallocation of resources first (where possible) when management change is needed will be used when developing the management responses described below as "mandatory collaborative" or "cooperative."

The Three Kinds of Management Response

The NFHCP outlines three general approaches for adapting management. Ideally, all potential management responses to all potential concerns would be specifically defined at the outset of the plan in order to provide the clearest possible business agreement and avoid the possibility of future disagreement over the extent of possible changes. However, those areas that contain the least amount of conservation certainty based upon the state of our existing knowledge are, as a matter of logic, the very ones that are most likely to require some change because of new knowledge. They are also the areas where the potential appropriate management response is the most difficult to describe. Plum Creek and the Services recognize that, not only is the development of the NFHCP a "creative partnership," but that the plan will function best if that partnership continues as adaptive management responses are devised during plan implementation. The three types of management responses used in the NFHCP are defined as follows:

1. **Pre-defined mandatory management response**. In some cases, we can specify at the outset of the plan the exact terms of the management responses that are necessary if a specifically measured condition, or "trigger," is tripped. This is most easily done with respect to those concerns for which there is reasonable certainty as to the accuracy and completeness of the current state of knowledge. In the NFHCP, implementation monitoring will provide measurements that most commonly will trigger pre-defined mandatory responses, which will typically consist of correcting management procedures.

2. **Mandatory collaborative management response**. This type of management change is mandatory if a specific triggering condition is observed, but the NFHCP does not specifically describe in advance exactly what that management response will be. The Services and Plum Creek must then mutually develop a response. While the response requires collaboration and agreement, it is not "open-ended" or undefined. Instead, the NFHCP provides procedures and standards to be applied in developing the response. Responses must be based upon data collected under adaptive management experiments or newly available data and must maintain or improve the ability to meet NFHCP biological goals while continuing to consider the NFHCP business goals. A mandatory collaborative change culminates upon the agreement of the Service(s) and Plum Creek to institute some management change.

3. **Cooperative management response**. As the term of the NFHCP proceeds, it is anticipated that clear opportunities for improvement will become evident. These opportunities are not dependent on a "trigger" being tripped, but are simply observations that there is a way to alter management activity in a fashion that better achieves NFHCP goals. A cooperative management response is designed to take advantage of these opportunities. For example, Plum Creek may observe an opportunity to improve a conservation commitment and request that the Services consider agreeing to the

improvement. The Services are free to do so or not. Once agreed to, however, the change becomes a mandatory, enforceable part of the NFHCP.

Adaptive Management Commitments

The first two adaptive management commitments (AM1 and AM2) involve committing to **monitor** the NFHCP for effectiveness using scientific experimentation, as well as to **evaluate** the monitoring data and make management **responses** when appropriate using the NFHCP Implementation Framework, thus incorporating an Adaptive Management feedback loop. The last two adaptive management commitments (AM3 and AM4) involve additional features that incorporate management responses into the NFHCP. The first (AM3) incorporates responses due to large natural events (changed circumstances), while the second (AM4) responds to more rigorously developed site specific analysis in certain key watersheds ("native fish assemblages").

AM1: NFHCP Effectiveness Monitoring and Core Adaptive Management Projects

In order to perform effectiveness monitoring and to identify and support adaptive management improvements to the NFHCP, Plum Creek commits to design and implement the following four **Core Adaptive Management Projects** (CAMPs) in cooperation with the Services.

1. Evaluation of road BMP effectiveness (CAMP 1).
2. Effect of riparian management on woody debris loads and fish habitat diversity (CAMP 2).
3. Evaluation of NFHCP effectiveness at avoiding stream temperature increases (CAMP 3).
4. Long-term effectiveness of Plum Creek's grazing BMPs (CAMP 4).

Commitments and descriptions for two additional Adaptive Management projects are already covered elsewhere in the NFHCP:

1. Effectiveness of riparian restoration along Key Migratory Rivers (see Lg3).
2. Gold Creek experimental brook trout suppression project (see Lg6).

The final study designs will be a collaborative agreement completed by the end of year 1 of the NFHCP and will be based upon the agreed conceptual designs described in Appendix AM-1. The monitoring data will be reported to the Services every 5 years. Projects will be designed to collect data to support:

- The tripping of a trigger
- A proposal to modify triggers
- Biological relevance determinations
- Description of causal linkage relationships
- The development of management responses

In addition to these Adaptive Management projects, Plum Creek commits to continuous improvement in mapping and understanding of the distribution of species covered by the ITP. Plum Creek will incorporate new fish presence data, including reintroductions, for all such species in the Project Area as collected by states and will continue to share results with states of Plum Creek fish surveys performed as part of the CAMP studies and elsewhere as may be performed as a cooperative management response. This information will be compiled on updated NFHCP fish distribution maps at each 5-year reporting period. Plum Creek will collect tissue samples during these surveys, when appropriate, to enhance species identification. These samples will be provided to the states for genetic analysis as a part of a cooperative working relationship to improve knowledge of the distribution of native salmonids. Improved fish distribution information will be one of the NFHCP tools available to make determinations of biological relevance, causal linkages, and for directing or focusing management responses.

Rationale:

Key inputs are needed to the Implementation Framework in order to make decisions about management responses. Many of those key inputs are already provided for in the NFHCP and referenced in the framework; they are primarily implementation monitoring and performance metrics provided by Administration and Implementation commitment A6.

Commitment AM1 provides for four scientific studies to lay the foundation for improvements to the NFHCP, in addition to two studies that are committed to elsewhere in the NFHCP. Of the total of six studies, five are intended to evaluate the effectiveness of NFHCP commitments at meeting the biological goals of the NFHCP and provide the basis for management changes if needed. The Gold Creek brook trout suppression project is primarily considered basic research. Most of the other studies also include elements of basic research as well. Basic research will yield information that adds to the understanding of biological relevance and relationships between land management actions and fish habitat utilization, but is not directly related to adaptive management "triggers."

More about the Fish Surveys

A commitment to continuous improvement in fish distribution mapping and understanding in the Project Area will be valuable input to the Adaptive Management Pathway. The Plum Creek fish surveys conducted prior to NFHCP development collected data for all species but were focused in areas where it was thought that bull trout could possibly occur. There is particular weakness in fish distribution knowledge for westslope cutthroat trout. This is because a sufficiently genetically intact westslope cutthroat trout that warrants protection under the ESA is impossible to distinguish from a hybrid fish without collecting fish tissue and performing a genetic analysis, a very expensive procedure. In the Project Area, maps showing the distribution of westslope cutthroat do not separate between populations that warrant protection under the ESA and those that do not. An improved understanding of the distribution of Permit species will improve the ability of the NFHCP to focus conservation on the needs of those species.

AM2: Evaluate and Respond: The NFHCP Implementation Framework

Plum Creek commits to improve the NFHCP over time by revising management practices according to the NFHCP Implementation Framework in Table NFHCP8-1 to ensure that the goals of the NFHCP will be met. Management responses may be broad in scope, such as a change in a programmatic commitment over the whole Project Area, or it may be very site specific. Management responses will be one or more of the following three kinds, as indicated in the Framework table:

1. **Pre-defined Mandatory Management Response:** The response is agreed in advance and set forth in the NFHCP. It requires no additional agreement between Plum Creek and the Services to be implemented. The pre-defined response also defines the scope or scale of the response.

2. **Mandatory Collaborative Management Response:** A management response is mandatory, but not specifically described in advance. The response is developed collaboratively between Plum Creek and the Service(s) based upon CAMP study data or newly available data. Agreement on the specific response by both Plum Creek and the Service or Services (based on their respective jurisdictions) is required when the Implementation Framework specifies that a management response must be made. Failure to reach agreement on this kind of response requires use of the dispute resolution process (specified in IA, subsection13.4.3) or may ultimately allow for partial suspension of the permit (IA, subsection 10.3). The purpose of the response will be to improve the ability of the plan to meet the NFHCP biological goals.

   When mandatory management responses require an additional commitment of resources, the Services and Plum Creek will first seek to find NFHCP components that can be demonstrated to exceed conservation expectations and revise management to reallocate resources if that opportunity is available. If a conservation surplus is not available and additional resources must be committed to maintain biological goals, Plum Creek and the Services will utilize the NFHCP business goals to guide the development of a response that ensures the NFHCP biological goals will be met.

   A mandatory collaborative response must be focussed on a small enough scale of the Project Area so that the demand for additional resources from Plum Creek is minimized yet broad enough to reasonably expect a correction in the effects of the NFHCP in achieving the biological goals.

3. **Cooperative Management Response:** The Services or Plum Creek may propose changes to the NFHCP at any time for the purpose of continuous improvement. Mutual agreement is required if a change is to be made, but a change is not mandated if mutual agreement cannot be achieved. Once agreed to, the change becomes a mandatory, enforceable part of the NFHCP. Any scale of management response may be instituted under a cooperative management response.

Implementing the Adaptive Management Pathway: Improvements in NFHCP commitments to better meet the biological goals are subject to the check points specified in the Adaptive Management Pathway.

- **Triggers** for science-based management responses derived from NFHCP effectiveness monitoring must meet the numerical measurement criteria specified in Table NFHCP8-1 and described in more detail in Table NFHCP8-2 and Appendix AM-1. If a science-based trigger derived from NFHCP effectiveness monitoring is tripped, the Adaptive Management Pathway proceeds subject to the requirements of a mandatory collaborative management response, including the determination of biological relevance and causal linkages.

  – **Modifying Triggers**. Triggers may be modified during the timeframe of the NFHCP as a mandatory collaborative management response if new information derived from the CAMP studies or from external new data indicate modification of a trigger is appropriate. A proposal to modify a trigger must be made in conjunction with the 5-year reporting cycle and, if changed, will apply during the subsequent 5-year reporting period.

If either Plum Creek or the Services desires to propose a change in the numeric value of a science-based trigger that leads to the Adaptive Management Pathway, the party must prepare a proposal containing the following:

- A demonstrated concern about an existing trigger that is based upon biological relevance.
- A demonstrated correlation between the habitat parameter being monitored by the trigger and the biological relevance of that parameter.
- Rationale and support for a revised trigger explaining and demonstrating how it alleviates the concern.

Using the proposal containing these elements, the new trigger will be developed as a mandatory collaborative management response. A trigger may not be set at a finer scale than the Planning Area Basin.

- **Biological Relevance:** After a science-based trigger has been tripped, a biological relevance determination associated with the trigger being tripped must be demonstrated based upon CAMP results (Appendix AM-1) or external information to proceed with the Adaptive Management Pathway. A "**biological relevance determination**" identifies when the tripping of a trigger negatively affects the conservation of Permit species indicating that the plan is falling short of meeting the NFHCP biological goals. The determination of biological relevance will be made mutually by Plum Creek and the Services as a mandatory collaborative management response using one or more of the following kinds of evidence:
  - Permit species habitat utilization in managed (experimental) versus control reaches of streams in the Project Area or vicinity
  - Definitive relationships between habitat utilization and the habitat parameters being measured that can be used to infer impacts to similar areas where habitat utilization is not being measured.
  - The context of overall habitat quality trends; the evaluation of a trigger in the context of overall trends for other habitat parameters may contribute to the relevance determination.
  - The context of baseline habitat conditions; the evaluation of a trigger in the context of an existing habitat baseline may contribute to a relevance determination.
  - Other data or definitive information (e.g., peer reviewed scientific articles from professional journals) that can inform a determination of whether a tripped trigger negatively affects the utilization of habitat by Permit species.

- **Causal Linkages:** When a determination of biological relevance is made, causal linkages will be evaluated based upon CAMP results and other data. A causal linkage exists when it is demonstrated that the source of departures from NFHCP expectations are caused by implementation of NFHCP management measures. If a causal linkage to the NFHCP is demonstrated, the Adaptive Management Pathway proceeds to the development of a management response. The demonstration of a causal linkage will also be by mutual agreement of Plum Creek and the Services, managed as a mandatory collaborative management response.

- **Management responses** will be developed based upon demonstrated causal linkages and applied in those locations where Plum Creek and the Services expect that there will be a demonstrable measurable correction in NFHCP results.

Timing: Reporting of actual NFHCP results compared to performance metrics will be due to the Services by June 30 following the end of the reporting year. For annual metrics reporting, the report

will include a discussion of management responses that will be implemented. Implementation will begin as soon as practicable, but no later than the beginning of the following operating season. For reporting of science-based effectiveness monitoring metrics conducted on a 5-year basis, performance compared to triggers will be reported by March 31 of Year 6 of the cycle. Mandatory collaborative management responses will be developed and implemented as soon as practicable; however, if agreement on a response is not reached by the end of Year 6, the matter will be subject to dispute resolution (see IA, Section 13.4). All management responses will be fully implemented by the end of Year 7 (unless extended because of dispute resolution, in which case an implementation schedule shall be developed as part of the dispute resolution process). This provides for a maximum implementation interval of 21 months from the time a trigger is tripped to complete implementation.

Rationale:

The Implementation Framework serves as the "blueprint" for implementing the NFHCP. The Framework table specifies the primary sources of information (monitoring and research) that will be used to generate the performance metrics, information to assess the biological relevance of a departure in expectations in NFHCP effectiveness, and data useful in identifying appropriate management responses for "mid-course" corrections. The Implementation Framework is a comprehensive guideline, directing the full range of management responses that might be expected under the NFHCP.

- **Implementation monitoring** will trigger responses in management procedures used by Plum Creek in meeting the NFHCP commitments. In these cases, the conservation commitments themselves do not change, but a determination is made that specific management procedures will be revised to improve the ability of Plum Creek to meet the commitments. The **white boxes** of the Implementation Framework table (Table NFHCP8-1) indicate NFHCP feedback loops based upon implementation monitoring.

- **Effectiveness monitoring** will trigger responses in NFHCP management measures that actually constitute a change in the substance of NFHCP commitments based upon scientific data. Such changes are the heart of adaptive management, where scientific procedures are used to test the success of the commitments in effectively meeting biological goals, and where new information arises and is used to evaluate the suitability of NHFCP commitments. The **black boxes** of the Implementation Framework table (Table NFHCP8-1a and b) indicate NFHCP feedback loops based upon effectiveness monitoring.

TABLE NFHCP8-1A

Explanation of Plum Creek NFHCP Implementation Framework Table

*The NFHCP Implementation Framework Table is the tool used by the NFHCP to specify when management responses are required if implementation targets are not met or when effectiveness evaluations show that the NFHCP is not meeting the NFHCP Biological Goals.**

Management response types are defined in commitment AM2. Each management response in this table includes a numeric reference to the NFHCP management response type that applies. These include: (1) pre-defined mandatory response, (2) mandatory collaborative response, or (3) cooperative response.

Black boxes in the table represent an effectiveness monitoring feedback loop. Management responses are generally changes in the substance of a conservation commitment.

White Boxes in the table represent an implementation monitoring feedback loop. Management responses are generally changes in the administrative procedures used to ensure effective implementation of conservation commitments (rather than a change in the substance of a commitment).

*For management responses specified by Planning Area Basin, the Western Washington Outliers will be considered as being a part of the Lewis River Planning Area Basin.

TABLE NFHCP8-1B

Plum Creek NFHCP Implementation Framework

Specific NFHCP Habitat Objectives	Management Actions	Performance Metrics	Triggers (If…)	Management Response (Then…)
Cold: **Biological Goal Number 1:** Protect stream temperatures where they are suitable for fish, and contribute to restoration of temperatures where past Project Area management has rendered them unsuitable.				
1. Minimize impacts to canopy closure and changes in channel morphology resulting from riparian timber harvest and grazing.	Implement riparian commitments (Rp1-Rp9).	Water temperature at reach or watershed scale. (CAMP3 results reported every 5 years.)	A statistically significant increase of 1.0° C in stream temperature relative to pre-treatment conditions is observed (Table NFHCP8-2, Trigger A).	When directed by the Adaptive Management Pathway, revise or create riparian prescription enhancements based on outcome of causal linkage evaluation (AM2) (2).
		Percent riparian rule compliance, as determined by a combination of state, internal and third party audits, determined every 5 years. (A6)	Compliance rate is less than 93%. (Trigger is based upon Montana statewide averages for 1996 and 1998)	Plum Creek will develop and implement an action plan for achieving higher compliance that will not trip the trigger (1).
	Implement Grazing BMPs (G1)	Metrics will be developed under CAMP4, defined at Year 5, reported every 5 years. May include: • Canopy cover • Width to depth ratio • Bank vegetation • Bank integrity	CAMP4 will provide trend information and evidence of causal linkages as continuous improvement monitoring. Specific triggers will be developed if warranted after year 5 as a mandatory collaborative agreement. (2)	Revisions to Grazing BMPs will occur if needed on 5-year intervals as a continuous improvement response, in cooperation with the Services (2). Plum Creek will provide proposed revisions to the Services. The Services will provide recommendations on the revisions, if they desire, within 30 days of receiving the proposal.

TABLE NFHCP8-1B
Plum Creek NFHCP Implementation Framework

Specific NFHCP Habitat Objectives	Management Actions	Performance Metrics	Triggers (If…)	Management Response (Then…)
		The total number of grazing leaseholder requirements met as a percentage of the total number of leaseholder requirements, as reported by local field offices (A6).	Compliance rate is less than 90%.	Plum Creek will develop and implement an action plan for achieving higher compliance that will not trip the trigger (1).
		Third party audit (A5) qualitative determination of implementation of leaseholder requirements and meeting intent of BMPs based upon sample audit.	A finding is made that indicates a departure or an opportunity for improvement.	Plum Creek will develop and implement an action plan to improve compliance (1).
	Evaluating status of vacated grazing leases before renewing (G4).	Evaluated by observation, third-party audit (A5).	A finding is made that indicates a departure or an opportunity for improvement.	Plum Creek will develop and implement an action plan for refining lease evaluation process (1).
2. Improve the ability of riparian vegetative communities to provide canopy closure over streams through passive and active restoration.	Riparian harvest deferrals (Rp1, Rp9).	Riparian harvest deferrals are required because of state streamside rules (Rp1) and are extended to additional stream reaches by Rp9; triggers are not required for NFHCP management change because no management prescription that is more conservative will be required. Trends in function provided by riparian vegetation will be measured in CAMP2 and will provide a context for evaluating canopy cover removal minimization in CAMP3.		
	Fencing of severely impacted stream reaches (G2); 100% by Year 9.	Miles of stream fenced (per G2) as a percentage of total miles of stream determined to require fencing (per Lg1), (A6) reported annually.	Less than 50% by the end of year 6.	Increase rate of fencing to achieve 100% by the end of year 9 (1).
	Active riparian restoration along impacted Key Migratory Rivers (Lg2).	While this commitment may help promote the "Cold" biological goal, its main benefit will be derived from improving habitat complexity. See Complex.		
3. Create a net increase in canopy cover provided by riparian stands.	See management actions listed for Specific Habitat Objectives #1 and #2 above.	Change in overall percent canopy cover provided by sampled riparian stands (CAMP 2 results reported every 5 years).	No net measurable increase in overall canopy cover (Table NFHCP8-2, Trigger B).	When directed by the Adaptive Management Pathway, revise or create riparian prescription enhancements based on outcome of causal linkage evaluation (AM2) (2).

TABLE NFHCP8-1B
Plum Creek NFHCP Implementation Framework

Specific NFHCP Habitat Objectives	Management Actions	Performance Metrics	Triggers (If…)	Management Response (Then…)
Clean: **Biological Goal Number 2:** Protect in-stream sediment levels where they are suitable for fish and contribute to restoration of in-stream sediment levels where they have been impacted by past Project Area management.				
4. Minimize sediment delivery to streams resulting from the construction of new roads and timber harvesting.	Enhanced standards for construction of new roads (R2).	Percent BMP compliance, as determined by a combination of state, internal, and third party audits (A5).	Compliance rate is less than 93%.	Plum Creek will develop and implement an action plan for improving compliance so that the trigger will not be tripped (1).
	State BMP/FPA compliance.	BMP Application rate (A6), reported every 5 years from internal, state, and third-party audits.	Compliance rate is less than 93%.	Plum Creek will develop and implement an action plan for improving compliance so that the trigger will not be tripped (1).
	Upgrade or abandon roads at a 2:1 ratio to new roads constructed (pay-as-you-go provision, R2).	Length of road upgraded or abandoned as a proportion of the length of road constructed by Planning Area basin, reported annually (A6).	Road upgrade/ abandonment to new road ratio is less than 2:1 in a given Planning Area basin.	No new roads will be constructed in the Planning Area basin until the road upgrade/abandonment to new road ratio equals or exceeds 2:1 (1).
	Effectiveness monitoring will be performed under Specific Habitat Objective #6, shown below.			
5. Reduce sediment delivery to streams from existing roads.	Upgrade old roads (R5).	Miles of road that are "In Compliance" per R3, measured annually (A6).	50% below pro-rated upgrade schedule (R5) evaluated annually by Plum Creek.	Accelerate upgrade schedule to be 0% below upgrade schedule within 3 years (1).
	Abandon surplus roads (R7).	Miles of road abandoned (R4,A6), reported annually.	50% below pro-rated abandonment schedule at Year 5.	Accelerate abandonment schedule to ensure 95% abandonment by R7 deadlines (1).
	Fix Hot Spots (R6).	Evaluated by observation, third-party audit (A5).	If third-party audit determines the intent of the Hot Spot commitment has not been met.	Plum Creek will develop and implement an action plan to address audit findings (1).
	Effectiveness monitoring will be performed under Specific Habitat Objective #6, shown below.			
6. Create a net reduction in sediment delivery to streams	See manage-ment actions listed under Specific Habitat Objectives #4 and #5 above.	Net percent sediment reduction, calculated from the baseline used in effects analysis (CAMP 1 study results reported every 5 years).	Net pro-rated (by time) sediment delivery reduction is significantly less than 49% (Table NFHCP8-2, Trigger C). Pro-rated reduction requires 10% reduction at 5-year review, 20% at 10-year review, and 30% at 15-year review.	When directed by the Adaptive Management Pathway, revise or create enhanced BMPs for new roads or old road upgrades based on outcome of causal linkage evaluation (AM2) (2).

TABLE NFHCP8-1B
Plum Creek NFHCP Implementation Framework

Specific NFHCP Habitat Objectives	Management Actions	Performance Metrics	Triggers (If…)	Management Response (Then…)
7. Contribute to restoration of the function of riparian vegetative communities for sediment filtration and streambank stability.	Key Migratory River restoration (Lg2).	See implementation and effectiveness monitoring for this NFHCP mitigation measure under Specific Habitat Objective #11 below.		
	Fencing (G2).	See implementation and effectiveness monitoring for this NFHCP mitigation measure under Specific Habitat Objective #11 below.		
Complex: **Biological Goal Number 3:** Protect instream habitat diversity where it is suitable for native fish and contribute to restoration of instream habitat diversity where it has been impacted by past Project Area management.				
8. Minimize impacts to large woody debris (LWD) recruitment and bank stability in harvested streamside stands.	Implement state regulations and NFHCP commitments. (Rp1-Rp9).	See Specific Habitat Objective #1 for compliance monitoring above.		
		Assumptions in LWD recruitment models used as a basis for NFHCP commitments (CAMP2 study results reported every 5 years).	Revised LWD forecasts using revised validated model assumptions in the first decade show that original LWD forecasts significantly over-estimated recruitment potential (Table NFHCP8-2, Trigger D) .	When directed by the Adaptive Management Pathway, revise or add enhanced riparian prescriptions based on outcome of causal linkage evaluation (AM2) (2).
		a) In-channel LWD in # of pieces per 1000 feet of stream , and b) Pool frequencies (CAMP2 study results reported every 5 years).	If LWD is unchanged and pools decrease, or if both LWD and pools decrease (Table NFHCP8-2, Trigger E).	When directed by the Adaptive Management Pathway, revise or add enhanced riparian prescriptions based on outcome of causal linkage evaluation AM2) (2).
9. Minimize impacts to overhanging stream banks because of grazing or riparian harvest.	Implement Grazing BMPs (G1).	Effectiveness monitoring and management response performed under CAMP4, stated under "Cold" Specific Habitat Objective #1 above.		
		Implementation monitoring and management response as stated under "Cold" Specific Habitat Objective #1 above.		
	Retain bank edge trees (Rp1 through Rp7).	Evaluated by observation, third party audit (A5).	Third-party audit determines bank edge trees are not being retained.	Plum Creek will develop and implement an action plan to address finding (1).

TABLE NFHCP8-1B
Plum Creek NFHCP Implementation Framework

Specific NFHCP Habitat Objectives	Management Actions	Performance Metrics	Triggers (If…)	Management Response (Then…)
10. Improve the ability of riparian forests to provide a broad scope of riparian function to streams.	Riparian harvest deferrals (Rp1, Rp9).	Riparian stand metrics; average tree size and relative density (CAMP2).	Effectiveness monitoring results will be used to determine success of Specific Habitat Objective #12.	
	Fixing up old roads (R5, R6).	While this commitment may help promote the "Complex" biological goal, its main benefit will be derived from improving habitat "cleanliness". See Clean Goal.		
	Road abandonment (R7).	While this commitment may help promote the "Complex" biological goal, its main benefit will be derived from improving habitat "cleanliness". See Clean Goal.		
	Engineered Habitat Restoration (Lg4).	Number and location of projects, reported every 5 years (A6).	Conservation benefits to Permit species from commitment Lg4 were not quantified in the effects analysis. Cost of future conservation actions will be weighed against measurable and identifiable project specific benefits to determine usefulness as a potential additional tool used under continuous improvement or cooperative management responses (3).	
11. Improve the function of riparian vegetative communities for overhanging banks and other habitat diversity through passive and active restoration.	Fencing (G2).	See implementation monitoring specified under Specific Habitat Objective #2 above.		
	Riparian restoration along Key Migratory Rivers (Lg2).	Miles of stream with projects implemented (per Lg2) as a percentage of total miles of stream determined to require restoration projects (per Lg1), reported every 5 years.	Less than 50% by the end of year 8.	Then increase rate of restoration implementation to achieve 100% by the end of year 15 (1).
		Metrics for Lg2 projects will be developed, monitored per Lg3 and reported every fifth year of the Permit. Potentially: • Vegetative cover • Width to depth ratio	No specific trigger. Monitoring study will **compare measurable benefits with costs** and inform future restoration for effectiveness and continuous improvement. As a mandatory collaborative management agreement, after the first 5-year report, Plum Creek and the Services will determine whether the development of triggers is warranted (2)	Continuous improvement response as needed in cooperation with Services. Refine measures utilized in future Lg2 projects to ensure cost effectiveness and conservation benefit (3). Plum Creek will provide a cost benefit analysis to the Services along with proposed revisions. The Services will provide recommendations on the revisions, if they desire, within 30 days of receiving the proposal.
12. Create a net increase in LWD recruitment potential and other riparian functions in the Project Area.	See management actions listed above under Habitat Objectives 7-10.	a) Riparian stand composition: Proportion of each riparian stand type through time, and b) Riparian stand metrics: average tree size and relative density within the stands (CAMP2 study results reported every 5 years).	No increase in size or relative density of trees in riparian stands over time. (Table NFHCP8-2, trigger F).	When directed by the Adaptive Management Pathway, revise or add enhanced riparian prescriptions based on outcome of causal linkage evaluation (AM2) (2).

TABLE NFHCP8-1B
Plum Creek NFHCP Implementation Framework

Specific NFHCP Habitat Objectives	Management Actions	Performance Metrics	Triggers (If…)	Management Response (Then…)
		a) In-channel LWD in # of pieces per 1000 feet of stream , and b) Pool frequencies (CAMP2 study results reported every 5 years).	Riparian stand re-measurements (Trigger F) will include LWD and pool data which will be reported. No specific triggers will be used because meaningful feedback is not expected for these reasons: • Very long time lags for LWD input from young stands • LWD changes are associated with stochastic events • Management history changes relationship between inputs and depletion.	
Connected: **Biological Goal Number 4:** Protect and contribute to restoration of connectivity among sub-populations of native fish in the Project Area.				
13. Avoid creating fish passage barriers when constructing stream crossings.	Enhanced new road BMPs (R2).	Evaluated by observation, third-party audit (A6).	Third-party audit determines fish passage is not being provided (per Appendix R-6).	Plum Creek will develop and implement an action plan for achieving compliance (1).
14. Restore fish passage where existing road stream crossings restrict passage.	Hot Spots for passage barriers (R6).	Passage barriers removed as a percentage of total known barriers that warrant removal (A6).	Less than 50% of known passage barriers that warrant removal per commitment R6 have been corrected by the end of year 10.	Accelerate fish passage fixes to achieve 100% correction of passage barriers that warrant correction by the end of year 15 (1).
15. Cooperate to restore fish migration where restricted by other means, such as irrigation diversions or thermal barriers.	Diversion management planning (Lg5).	Number of diversions in compliance with management plan as a percentage of total (A6).	Less than 50% of known diversions in compliance with management plan (Per Lg5) by the end of year 2.	Plum Creek will ensure all diversions are in compliance with management plan developed and implemented by August of year 3 (1).
		Evaluation of implementa-tion versus intent, by third party audit (A5).	Third-party audit determines the intent of Lg5 has not been met.	Plum Creek will develop and implement an action plan for achieving higher compliance (1).
Mitigation for substantive non-compliance:		Compliance with NFHCP commitments as determined by state or external audits, or otherwise observed by the Services and reported to Plum Creek.	There is a departure from NFHCP compliance that is considered a “major departure”. A major departure is a departure from NFHCP compliance that results in a measurable, material loss of riparian function.	A plan to mitigate for riparian function lost because of departure will be proposed by Plum Creek within 30 days for review and agreement by Services. If the Services do not respond within 30 days, Plum Creek shall implement the plan as proposed. All plans requiring affirmative mitigation measures will be implemented within 1 year, unless agreed otherwise (2).

TABLE NFHCP8-2
Plum Creek Adaptive Management Trigger Detail Table
Additional detail for science-based triggers specified in the Implementation Framework, Table NFHCP8-1, as determined by NFHCP Effectiveness Monitoring and the CAMP studies (see Appendix AM-1)

Trigger and Activity	Explanation of Trigger
Trigger A SHO 1 CAMP 3	**Are impacts to stream temperature from riparian harvest minimized?** The trigger is a statistically significant (alpha=0.1) increase of 1.0^{o}C in maximum weekly average temperature based on a pooling of all measured sites.
Trigger B SHO 3 CAMP 2	**Is there a net increase in canopy cover in riparian stands?** Trigger B will be considered tripped there is significantly less (alpha = 0.1) than a 2% per decade increase in canopy cover measured against the starting point in year 1. Based upon riparian stand measurements taken for trigger F, the average canopy cover for the Project Area will be calculated using the Forest Vegetation Simulator (FVS) model. Because modeled increases in canopy cover were initially estimated to be relatively modest, a change of canopy cover is not expected to be measurable before year 10.
Trigger C SHO 6 CAMP 1	**Is there a net sediment delivery reduction considering both new road construction and old road upgrades?** The trigger will be observed if the pro-rated sediment reduction calculated across the Project Area is 30% or less, which is significantly less (at approximately 1 standard deviation) than the average weighted reduction of 49% calculated in the effects analysis. All watershed RSDAs will be averaged (i.e., weighted by watershed road length evaluated) to calculate net sediment reduction. The pro-rated reduction (by time) will require a 10% reduction by the 5-year review, 20% by 10-year review, and 30% by 15-year review.
Trigger D SHO 8 CAMP 2	**Did the NFHCP forecasts accurately show impacts to woody debris recruitment associated with riparian harvest?** The trigger is observed if forecasts using assumptions validated under CAMP 2 show that initial forecasts overestimated woody debris recruitment by 20% or more. This trigger will apply to the first decade of the permit period (i.e. the first two 5-year reporting periods). The use of model validation for monitoring effectiveness for the first decade is necessary because long time frames are required to actually measure woody debris recruitment effectiveness. Reliance on the model is expected to diminish after the first decade at which time trigger E will be used.
Trigger E SHO 12 CAMP 2	**Is LWD recruitment potential increasing over the Project Area?** The trigger will be tripped if, by year 15, the relative density and average diameter of the largest 88 tpa in riparian stands has decreased or stayed the same. Riparian stand composition in the nine dominant riparian stand types (Plum Creek 1999a) will be re-measured every 5 years, starting in year 10.
Notes: Provisions governing the changing of values used for triggers in order to meet the NFHCP biological goals are specified in commitment AM2. Different triggers applying to different geological types or Planning Area Basins can be developed if warranted based on data. SHO = Specific Habitat Objective CAMP = Core Adaptive Management Project	

AM3: Changed Circumstances

A "**changed circumstance**" is a change in the circumstances affecting a Permit species that can be reasonably anticipated allowing a plan to be developed in advance to accommodate the change. All changed circumstances anticipated in the NFHCP are identified below. Promptly after a changed circumstance is discovered, the appropriate Service will be notified and invited to help craft a site-specific management plan. The components and framework for management plan development are set forth in Table NFHCP8-3. The changed circumstance management plan will be developed as a mandatory collaborative management response, but will be subject to the following additional procedures and criteria:

- Plum Creek is responsible for preparing the plan, with the Services assistance (if desired by the Services), and submitting the plan to the Services within 30 days of observing the changed circumstances
- A plan must be completed and agreed upon by Plum Creek and the Services within 60 days of submission of Plum Creek's proposed plan. If this has not occurred, the matter will be resolved using the NFHCP dispute resolution provisions (see IA, in Appendix A of the DEIS, Section 13.4).
- If the Services do not comment on the submitted plan within 30 days of receiving it, the plan shall be implemented as proposed.
- The plan must contain the components described in Table NFHCP8-3.
- Implementation timing will be specified in the plan and shall be as prompt as is reasonably practicable.

Changed circumstances considered possible in the NFHCP Project Area, including their specific lower and upper ranges, are as follows:

Forest fires that are stand replacement fires between 300 and 5,000 contiguous acres of the Project Area in size, or that directly affect between 25 and 50 percent of Project Area stream length within a given fourth order watershed. "Stand replacement" is of sufficient intensity to kill 90 percent or more of the trees (i.e., a fire that would necessarily result in the need to establish a new stand).

Flooding when the flood has a recurrence interval between 25 and 100 years based on stream gauging station data in the Planning Area.

Landslides between 500 and 5,000 square yards in size that deliver sediment to streams.

Rationale:

The NFHCP is a conservation planning effort covering a dynamic forested landscape that is subject to change because of expected and reasonably foreseeable natural occurrences. The Services are required to ensure changed circumstances are identified and planned for in the NFHCP. A plan that anticipates these changed circumstances and has a procedure for addressing them adds conservation value by reducing potential risks associated with them. This provides the Services with additional assurance that certain actions will take place that provide a level of conservation certainty given a relatively predictable but unplanned event, and it gives Plum Creek the assurance that it will not be held accountable to fully compensate for impacts of natural events or events that are outside its control. Some changes are not

significant and therefore do not warrant being addressed by these procedures, while others may be sufficiently large or unforeseeable that they will be addressed separately and under the assurances provided by the "No Surprises" rule. These are termed "unforeseen circumstances" in that rule. Therefore, changed circumstances are represented as a range that is sufficiently large that it may have a material impact, yet not so large as to make them unforeseeable. Circumstances smaller than the lowest end of the range are considered inconsequential, and Plum Creek need not change routine management actions if they occur. Circumstances greater than the upper end of the range are considered to be unforeseen, and the NFHCP does not specify what management actions are required if they occur. If unforeseen circumstances occur, the government may work with Plum Creek to develop mitigation measures to address environmental problems, but, under the No Surprises rule, it would not ask Plum Creek for additional land or money as mitigation.

Forest fires, flooding, and landslides were identified by Plum Creek and the Services as being changed circumstances most relevant to the NFHCP. Table NFHCP8-3 shows the management planning framework for changed circumstances. The rationales for the lower and upper range of these changed circumstances are discussed in the following table.

TABLE NFHCP8-3
Site-Specific Management Planning Framework and Components for the NFHCP

Changed Circumstance	Site-Specific Management Planning
Forest Fires	An impact assessment will be conducted on the effect of the fire on the NFHCP biological goals and objectives. A rehabilitation plan will be developed and implemented. Examples of rehabilitation actions include grass seeding erodible slopes, expeditious tree planting, restricting ground-based equipment around streams, and enhanced skid trail and road drainage where hydrophobic soils have been created due to intense wildfire. In addition to this plan, Plum Creek will disclose fire salvage timber harvest plans to the Services.
Flooding	An aerial reconnaissance in the flood area will be performed as a broad screen to trigger a field inspection if there is visual evidence of flood damage to road systems. When triggered as a result of aerial observation, a road and stream crossing field inspection will be conducted in the principally affected portion of the flood-area within one operating season. Road maintenance (R8) and Hot Spot (R6) procedures will be used to address damage caused by the flood.
Landslides	When landslides between approximately 500 and 5,000 square yards are detected, sediment delivery will be confirmed through aerial or on-the-ground investigation. Where sediment delivery has been confirmed, an on-the-ground investigation will determine the extent and magnitude of impact to the aquatic system and NFHCP biological goals and objectives.
For All	A site-specific action plan will be developed and implemented to address the changed circumstance. The plan will: – Make a determination of the causal linkage. – Identify opportunities to reduce or eliminate ongoing impacts resulting from the event.

Forest Fires: Intensities of forest fires in the Planning Area vary from low to high. In most cases, low to moderate intensity fires are relatively small in size (tens to a few hundred acres), kill only some of the trees in the burn area, and do relatively little environmental damage. High intensity fires are typically stand replacing, tend to cover large areas (thousands of acres), and can cause both extensive and concentrated environmental impacts during and after the fire. For purposes of NFHCP planning, stand-replacing forest fires between 300 and 5,000 contiguous acres were selected as a reasonably foreseeable changed circumstance for the Project Area. At the Services' suggestion, an additional trigger was added to evaluate impacts within a given watershed (as a percent of the stream length affected by fire).

Floods: Floods with less than 25-year recurrence intervals are very likely to occur during the term of the NFHCP (see sidebar article). Because historic BMPs and Forest Practice Act regulations have required drainage features to accommodate **at least** the 25-year flood, it is expected that floods of this magnitude and less will have little environmental impact. The floods of 1996/1997 exceeded the 25-year event in many parts of the Project Area. As such, damage that could be caused by floods of that size has recently occurred and rehabilitation made. Floods with a recurrence interval in excess of 100 years are not reasonably foreseeable. Thus, floods with a recurrence interval of between 25 and 100 years are reasonable to consider as a changed circumstance. To determine if a portion of the Project Area experiences a 25- to 100-year flood, Plum Creek hydrologists will annually monitor floods on U.S. Geological Survey Internet sites that have real-time flow information. These data will be used to isolate those portions of the Project Area that may have experienced a changed circumstance from flooding.

Flood Probabilities

What is the chance that a flood of a particular magnitude will occur during the planning period? The probability that a flood with a recurrence interval of "T" years occurring or being exceeded at a given location over the 30-year permit period is predicted by the following equation (Dunne and Leopold 1978):

$$\text{Probability} = 1 - (1 - 1/T)^{30}$$

As such, the chances that various floods will be experienced at a given location during the term of the NFHCP are as follows:

5-year flood:	100%
10-year flood:	96%
25-year flood:	71%
30-year flood:	64%
50-year flood:	45%
100-year flood:	26%
200-year flood:	14%
500-year flood:	6%

Landslides: While rates of landsliding are low throughout much of the Project Area (Plum Creek 1998a), they can and do occur. Some of these landslides can be related to forest management activities, and many are natural. A landslide of less than 500 square yards (67 feet by 67 feet) is generally considered small (WFPB 1995) and was selected as the lower limit of the changed circumstance. Landslides that encompass as much as 5,000 square yards are considered large (WFPB 1995), and were selected as the upper limit of the changed circumstance. Landslides greater than 5,000 square yards are very large, rare, and unforeseeable. Small landslides (less than 500 square yards), when discovered, are addressed as part of the ordinary management under the NFHCP—See Commitment R6, *Hot Spot*

Treatments. Landslide area (square yards) was selected as the metric because this can be estimated from the air. Estimating landslide volume requires on-the-ground inspection.

AM4: Native Fish Assemblages

Native Fish Assemblages (NFAs) are areas considered to contain unique assemblages of native species diversity. Watersheds in the Planning Area to be designated as Native Fish Assemblages are as follows:

- Elk Creek (Swan Planning Area basin, Montana)
- Fishtrap Creek above Jungle Creek (Middle Clark Fork Planning Area basin, Montana)
- Keeler Creek (Lower Kootenai Planning Area basin, Montana)
- North Fork Blackfoot River (Blackfoot Planning Area basin, Montana)
- Quartz Creek (Middle Kootenai Planning Area basin, Montana)
- Vermillion River (Lower Clark Fork Planning Area basin, Montana)
- Pine Creek (Lewis River Planning Area basin, Washington)
- Ahtanum Creek (Ahtanum Creek Planning Area basin, Washington)

Special management will be undertaken in these watersheds in a partnership between Plum Creek and the Services. This "experimental approach" will involve collaborative watershed analysis and prescription development. Management will begin with NFHCP prescriptions, but will be supplemented with a more customized approach to prescription development.

Specifically, Plum Creek will take the following actions in NFAs:

- **Limiting factors analysis**—Assessment of the environmental, biological, and/or management factors that limit fish populations in the area.
- **Watershed analysis—**Assessment of watershed conditions and sensitivities on Project Area lands in the NFA using focused modules similar to those used in Washington Watershed Analysis (e.g., stream channel, riparian function, fish habitat condition, and mass wasting modules completed by qualified watershed analysts) or other techniques (geomorphic guilding, etc).
- **Accelerated old road upgrades**—Put road BMP upgrades in selected NFAs on a "fast track" (See R5, *Upgrade of Old Roads*).
- **Develop and implement prescriptions**—Plum Creek will develop additional watershed-specific prescriptions, if needed, and submit them to the affected Services for agreement as a mandatory collaborative management response. The additional prescriptions must be derived from specific causal linkages or other opportunities identified as a result of the limiting factors or watershed analysis. If the Service(s) do not respond to Plum Creek within 60 days of the submission of prescriptions, the prescription submitted shall be considered as agreed upon.

Timing: These actions will be initiated within 1 year of Permit issuance and complete within 10 years. In order to ensure that conservation options are preserved without unnecessarily limiting Plum Creek management opportunity, four of the NFA watersheds are selected for higher priority completion based upon likelihood of management activity. These are Fishtrap Creek, Pine Creek, and Ahtanum Creek. These will be complete with prescriptions developed in conjunction with or prior to the first 5-year reporting period. Additionally, road upgrades for all watersheds will commence immediately upon Permit issuance, in advance of analysis, and will be complete by the end of the fifth year of the NFHCP.

Rationale:

In the development of the NFHCP, the Services encouraged Plum Creek to take a more customized and experimental approach to conservation in a few key watersheds. This additional conservation feature is intended to diversify and supplement the conservation provided by the NFHCP package.

The NFA commitment was developed to add an element of conservation certainty to the NFHCP. The concept is to identify streams that serve as core areas within a connected basin. These are streams thought to contain high numbers of individuals of the various Permit species as well as the greatest variety of those species, forming key assemblages of native species diversity. These core areas, then, are to receive an approach to conservation that is more customized to actual causal linkages identified uniquely in that watershed. The intent is to reduce risks even further to these populations so that they might serve as a core of native fish integrity within the larger connected river basin. It helps ensure the NFHCP meets the "protect the best" idea expressed in the state of Montana's Bull Trout Restoration Plan and the biological goals of the NFHCP, and it applies the strategy to assemblages of species rather than just bull trout.

NFA watersheds were selected based on the following general biological criteria:

- Basin size, bull trout presence
- Bull trout population fitness
- Genetic integrity and richness of other native species such as westslope cutthroat

Interestingly, one of the larger challenges in identifying the NFA watersheds selected for the NFHCP was identifying where those populations of westslope cutthroat occur that are genetically intact. Westslope cutthroat have widely interbred with other fish species not native to the Project Area. These include rainbow trout and Yellowstone cutthroat that were extensively planted for many decades. The challenge is that expensive laboratory analysis is required to identify a genetically pure individual from one that is a hybrid. Ensuring that core areas of pure-strain westslope cutthroat are identified and conserved is an important conservation benefit. This approach will be strengthened if cooperative working relationships with states can be nurtured so assumptions of genetic purity can be tested and governmental fisheries management decisions can be made accordingly.

Information gained through these NFA site-specific analyses will help identify whether additional conservation risks or opportunities may be present in other portions of the Project Area that should or could be addressed through Adaptive Management. Also, these areas may provide important long-term reference sites for comparing watersheds that may receive standard levels of conservation under the NFHCP. Such benchmark sites could help to evaluate the effectiveness of those conservation measures being implemented throughout the remainder of the Project Area.

AM5: Landslide Monitoring

Landslides occurring since NFHCP implementation on Project Area lands will be monitored as Plum Creek personnel or others discover them. For each landslide discovered, data will be collected on the dimensions of the slide, the physical setting, and potential causal factors. This information will be complied and summarized for the 5-year reviews. Findings of this monitoring could be the basis for a Cooperative Management Response.

To facilitate consistent monitoring, a "landslide occurrence form" will be developed for inclusion in the Field Implementation Manual.

Rationale:

This commitment will provide a mechanism for evaluating trends in landslide occurrence over time in response to implementing the NFHCP. It may also highlight deficiencies in particular practices that could be addressed through a Cooperative Management Response.

AM6: Designation of Additional Tier 1 Watersheds

Additional third or fourth order watersheds may be added to the NFHCP as Tier 1 watersheds, irrespective of fish species present in those watersheds, according to the provisions specified in this commitment. When agreement is made to change a watershed from Tier 2 to a Tier 1 watershed, Plum Creek will apply Tier 1 prescriptions to all new projects initiated after the agreement.

The provisions for adding Tier 1 watersheds are as follows:

- In conjunction with the 5-year reporting cycle, the Services or Plum Creek may propose the addition of one or more Tier 1 watersheds.
- The proposal must contain biological justification of the proposed designation for each watershed as well as any fisheries survey data collected to support said designation.
- A proposal will automatically trigger a mandatory collaborative management response; agreement must be reached by the end of year 6 of the reporting cycle.
- No more than 12 watersheds, not to exceed a total of 46,200 acres, may be changed from Tier 2 to Tier 1 using this procedure.

Additionally, Plum Creek or the Services may propose to change additional watersheds from Tier 2 to Tier 1 or from Tier 1 to Tier 2 at any time as a cooperative management response.

Rationale:

The development of the NFHCP utilized the best information available on the distribution of Permit species to make the designation of a list of Tier 1 watersheds for the purpose of implementing a different risk strategy for 5 of the 55 conservation commitments. During the public comment period on the Draft NFHCP, the Services became concerned that the NFHCP lacked the flexibility to adapt to new fish distribution information that might dictate

the need to consider adapting the plan to change a designation for a watershed from Tier 2 to Tier 1. Plum Creek has a concern over "safe harbor." That is, if the Tier 2 conservation commitments are sufficient that certain species are re-attracted into certain watersheds, it should not create an obligation for more costly conservation commitments. This commitment, which was added to this final NFHCP, provides a process to increase the amount of Tier 1 watersheds by approximately 15 percent, recognizing that there may have been some legitimate oversights in the original list of Tier 1 watersheds, despite the use of the best information available.

Watersheds that might be considered for a change to Tier 1 might include a) discoveries of additional watersheds used by bull trout for spawning and juvenile rearing, or b) watersheds that are considered essential for the population viability of other Permit species (e.g. areas supporting pure genetic stocks and/or capable of acting as a source area to support metapopulation dynamics within a given Planning Area basin). This commitment provides the Services or Plum Creek with an opportunity to provide additional conservation measures to these watersheds through their designation as Tier 1 Watersheds.

When an addition to Tier 1 has been proposed, the parties will be given the opportunity to evaluate and agree to these designations by review of the data and documentation used to justify additional conservation. For example, if the Services wish to propose designation a new Tier 1 Watershed based on the findings of a presence/absence survey conducted by another party, Plum Creek will have the opportunity, through the mandatory collaborative management response process, to validate this information by conducting its own surveys and to discuss concerns that it may have with such a designation.

This commitment provides an opportunity to adapt the plan based upon better information in the future while still providing the landowner with reasonable assurances.